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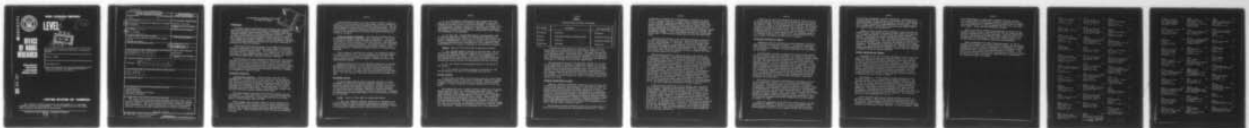
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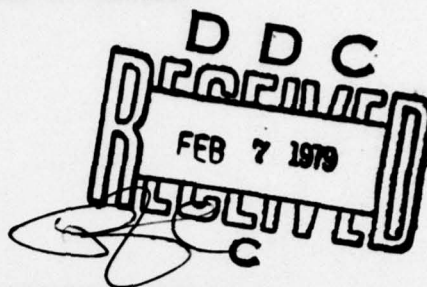
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## ONR LONDON REPORT

R-8-78

# LEVEL II

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AN OVERVIEW OF ELECTRONICS EDUCATION IN POLAND AND ROMANIA

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20 November 1978

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## AN OVERVIEW OF ELECTRONICS EDUCATION IN POLAND AND ROMANIA

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### INTRODUCTION

To promote mutual understanding and friendship among peoples and nations and in recognition of the benefits of exchanging scientific ideas and knowledge, the US National Academy of Sciences (NAS) has established exchange programs with Eastern European countries. I spent the month of June 1978 as an Exchange Scientist under the auspices of NAS, dividing my time roughly equally in Poland and Romania. This article reports some factual information as well as my personal impression of the engineering education in general and electronics education in particular in these two countries.

Both Poland and Romania are members of the USSR-dominated Warsaw Pact and of the Council for Economic Assistance (CEMA), a Soviet bloc economic coordinating organization. The governments of both countries are controlled by a Communist Party. It is expected that the governing structures of their engineering schools would be similar; but, since these schools predate WWII, they have their own traditions.

We shall begin with some background information about the history, geography, and people of Poland and Romania. The various engineering degrees and their qualifications are then discussed; so are also the different faculty ranks and their teaching loads and approximate monthly incomes. The organization and some of the research work in the technical universities of Poland and the polytechnic institutes of Romania are described in separate sections.

### BACKGROUND INFORMATION

Polish People's Republic. Poland's history goes back about a thousand years. It began in the seventh decade of the 10th century when Mieszko I founded the first Polish royal line. The partition in late 18th century by Prussia, Austria, and Russia brought the country under more than 120 years of servitude. After WWI, in 1919, Poland reappeared as an independent state. Twenty years later, in 1939, it tragically fell prey to Nazi Germany. Great sufferings followed, and not until 1945 did it become a sovereign state again.

The postwar Poland has an area of 312,700 km<sup>2</sup>, roughly the size of New Mexico. It has a population of about 35 million, of which more than 90% are Roman Catholics. In area and population Poland ranks second in Eastern Europe, after the USSR.

Women outnumber men in Poland. There are on the average 106 females to 100 males. Girls make up 71% of the pupils at general secondary schools and 45% at vocational schools. Approximately 50% of engineers, 64% of medical doctors, 80% of dentists and 84% of pharmacists are women. About 1000 women hold senior university appointments in Poland.

Warsaw, Poland's capital city, was reduced to rubble in WWII as a result of Nazi occupation and of brutal German reprisals against the unsuccessful uprising by Polish underground elements in 1944. Now the rebuilt Warsaw is a bustling city of 1.5 million inhabitants. The oldest university in Poland is Jagiellonian University in Cracow; it was founded in 1364 by King Casimir the Great and pre-dated Harvard University by 272 years.

Socialist Republic of Romania. The territory of Romania was inhabited by the Dacians (a Thracian tribe) around 400 B.C. Since then it has been the scene of many invasions and migrations. The Romans, in particular, having colonized it from 98 to 271 A.D., left their mark upon the country and its inhabitants. The Romanians remain essentially a Latin people surrounded by Slavic and Hungarian neighbors. Their principal religion, the Romanian Orthodox, however, is inherited from Byzantium.

After centuries of hardship and struggle, an independent Romanian state was achieved in 1877. It was a monarchy until its abolishment in 1947 when it was proclaimed the Romanian People's Republic. The name was changed to the Socialist Republic of Romania in 1965 by the Grand National Assembly.

Romania occupies an area of 237,500 km<sup>2</sup>; roughly that of New York and Pennsylvania combined. It has a population of about 22 million, and Bucharest, the capital city, has over 1.8 million inhabitants. The city is 500 years old, but it presents a well-planned mixture of the old with the new. It boasts many stately buildings and wide boulevards. Very few evidences remain from the destructive earthquake of 1977.

#### ENGINEERING DEGREES

In the European tradition higher technical education in Poland and Romania is conducted in separate independent schools, not in engineering colleges within larger universities. College-level institutions in Poland are the technical universities and those in Romania are called polytechnic institutes. Admission to these institutions is based on the results of competitive entrance examinations. The types and requirements of engineering degrees in the two countries are similar but not the same.

Poland. There are three types of engineering degrees:

1. Mgr. inż. (Magister inżynier)—Equivalent to the Master's degree; normally four years of full-time study plus one semester to do a thesis. There is also a four-year degree without the Master's thesis. It is called Inż. (Engineer) and is close to the BS in the US.



2. Dr. inż. (Doctor of Engineering)—The candidate must first pass two oral examinations; one on Marxist philosophy or political economy and the other on basic scientific knowledge. A doctoral dissertation based on original research is evaluated by two reviewers (one from outside the candidate's department). The candidate defends his work before a council consisting of all Professors and Docents (Associate Professors) of the department.

3. Dr. hab. inż. ('Doktor Habilitowany' of Engineering)—This is a kind of superdoctoral degree for distinguished contribution in an area of specialization, usually five or six years after the Dr. inż. degree. Recommendation of such a degree is based on the presentation of another dissertation and a demonstration of the candidate's total accomplishment; it is subject to approval by the Ministry of Education.

Romania. There are also three types of engineering degrees:

1. Ing. (Diploma Engineer)—Similar to the Polish Mgr. inż. degree, but the Romanian student must complete five full years of prescribed work, including a thesis. There is a strong emphasis on education-production integration, so 144 hours of workshop activities are required in each term for the first three years and 18 hours of research and design activities are specified for the last two years.

2. Dr. ing. (Doctor of Engineering)—Similar to the Polish Dr. inż. degree.

3. D. Sc. (Doctor of Science)—Similar to the Polish Dr. hab. and the British D. Sc. which is a step higher than the Ph.D.

#### FACULTY HIERARCHY

In both Poland and Romania there are four university faculty ranks which correspond roughly to the ranks of Professor, Associate Professor, Assistant Professor, and Instructor in US colleges. These are shown in Table 1. A Doctor's degree is normally required for the three top ranks.

The Professorial rank in Poland is further divided into two grades, namely, Ordinary, (Prof. zw.) and Extraordinary (Prof. nadzw.), the former being the higher grade. The teaching load for Professors is about 200 hours a year or approximately 7 hours per week. A Professor draws a base salary of about 8,000 zlotys a month. (The present official exchange rate for foreigners is 33.20 zlotys to 1 US dollar.) By doing contract research work, a Professor is allowed to earn 70% more than his base salary. It should be noted that in a socialist country there are no taxes and the government provides for education, health-care, and pension. Lodging is by assignment and is very inexpensive.

TABLE 1

## Faculty Ranks in Poland and Romania

In Poland	In Romania	U.S. Equivalent
Professor	Professor	Professor
Docent	Associate Professor (Conferentiar)	Associate Professor
Adjunct	Lecturer	Assistant Professor
Assistant	Assistant	Instructor

In Romania the base salary for a Professor is about 5,000 lei a month which can be augmented 25% by doing contract research. (1 US dollar equals 12 lei at the official rate.) The weekly teaching load is 12 equivalent hours. Each lecture hour is counted as one and one-half equivalent hours, and an hour in the laboratory is one equivalent hour. The maximum percentages (ceilings) of Professors and Associate Professors on a faculty are 12% and 16%, respectively.

The governing structures of the technical universities in Poland and the polytechnical institutes in Romania are similar. At the top is the Senate which consists of a rector; vice rectors; faculty deans; representatives of the Romanian Communist Party, the Trade-Union Association, and the Communist Students Association; representatives of the teaching staff and students from each faculty; and representatives from industry. The rectors and vice rectors are elected by the Senate and the Deans by Faculty Councils for three- (in Poland) or four- (in Romania) year terms.

TECHNICAL UNIVERSITIES IN POLAND

There is a technical university in each large city in Poland, but a separate Electronics Faculty exists only in the technical universities at Warsaw (Warszawa), Danzig (Gdańsk), and Breslau (Wrocław). The Technical University of Warsaw with 23,000 students is not only the largest technical university but also the largest of all universities in Poland. Its Electronics Faculty is divided among five Institutes; namely, Institute of Basic Electronics, Institute of Automatic Control, Institute of Radioelectronics, Institute of Electron Technology, Institute of Telecommunications, and Institute of Computer Science. In recent years the annual output of this Faculty has averaged about 110 Inż.'s, 240 Mgr. inż.'s, and 26 Dr. inż.'s.

The Institute of Basic Electronics alone has a teaching staff of about 95 plus an administrative and supporting staff of 35. It has



4 Professors (2 Ordinary and 2 Extraordinary), 5 Docents, and 20 Adjuncts. Currently there are 12 research groups working on synthesis of active systems, topological methods of linear network analysis and design, nonlinear network theory, analog electron circuits, pulse and digital electronics, biocybernetics, microwave and solid-state electronics, optoelectronics, measurement of nonelectrical quantities, digital measurement systems, parameter measurements of nonlinear networks, and reliability problems. It is a very active Institute and is doing high-quality work. I did not have an opportunity to visit the other Institutes.

The Electronics Faculty at the Technical University of Danzig is one of the University's nine faculties. Danzig was made a Free City in 1918, after World War I. Since then, it was one of Europe's most sensitive trouble spots. It was there the first shots of WWII were fired from the German battleship Schleswig-Holstein on 1 September 1939. Like Warsaw, about 85% of the city was destroyed. Also like Warsaw, most of the city's historical buildings as well as landmarks have been painstakingly rebuilt and restored.

The Electronics Faculty at Danzig has about 1,000 students and consists of 3 Institutes: Institute of Telecommunications, Institute of Cybernetics, and Institute of Electronic Technology. The Institute of Telecommunications alone has a total staff of 200, and its teaching duties are distributed among 6 Chairs: in microwaves, electroacoustics, radio communication, wire communication, theory of electronic circuits, and information system theory. Because of my own special interest, I visited the microwave laboratories of Professor dr. hab. inż. Krzysztof Grabowski. Current research projects there include passive MIC (microwave integrated circuit) devices, automation of microwave measurements, receiver-noise elimination, frequency stabilization of X-band radio link, and wave propagation in anisotropic media. The people are competent and dedicated. One staff member is interested in the problem of detecting underground running water by radiation measurements. It appeared that he could detect radiation in the neighborhood of 1.42 GHz over underground running water at some locations.

I did not have an opportunity to go to Breslau, but I did visit the electronics institutes at the technical universities in Łódź and Cracow (Kraków). Łódź (pronounced "wootch," believe it or not!) with a population of 800,000 is the second largest city of Poland. It is an industrial city and is known as the "Manchester of Poland" because of its many textile factories. Fortunately it did not suffer much destruction in WWII. There is no separate Electronics Faculty at Łódź, but there is an Institute of Electronics that is four years old. The Institute has a teaching staff of 46 and an administrative and supporting staff of 15. No microwave work is done there. The Institute has been involved in instrumentation work, as well as in the design and fabrication of 5-kW, 20-25-kHz ultrasonic generators and of testing apparatus for TTL circuits. Some work on microprocessors and computer-aided design is also being carried out.



Cracow was the seat of Polish monarchs from the 11th to the end of the 16th century and hence is rich in historical, cultural, and intellectual heritage. By some miracle of fate it escaped the havoc of the last war. Today it is a prosperous city of 700,000. The Technical University at Cracow is 32 years old and has 6 faculties, but it does not have a separate Electronics Faculty. The Institute of Electronics, established in 1974, is a part of the Faculty of Transport. It has a teaching staff of 37 and an administrative and supporting staff of 14. The main interest of the staff lies in electric machines, automatic control, and digital and analog circuit modules.

#### POLYTECHNIC INSTITUTES IN ROMANIA

Engineering schools in Romania are called polytechnic institutes. There are four such institutes in Romania: at Bucharest, Timisoara, Cluj, and Jassy. In addition, electrical engineering is also taught at the universities in Frasov and Craiova where there are no polytechnic institutes.

The Polytechnic Institute of Bucharest has about 25,000 students and is the largest university in Romania. Its original buildings near the North Railway Station are rather old, but a much more spacious campus with impressive new structures is being built in another section of the city. The Department of Electronics is a part of the Electrical Engineering Faculty. It has a teaching staff of 3 Professors, 4 Associate Professors, 4 Assistant Professors, and 10 Instructors. A large number of textbooks have been published by the faculty. The books are all in Romanian, but a casual examination indicated that the coverage and treatment are comparable to those written in English for the same level. On-going research projects in the microwave area include synthesis and optimization of antenna arrays, frequency-scanned X-band waveguide slot arrays, digital radar speed measurement, high-power magnetrons and circulators.

The Polytechnic Institute of Timisoara has 5 faculties, in electrical, mechanical, chemical, civil, and agricultural engineering. The Electrical Engineering Faculty has 2,000 students and comprises 4 departments: electrotechniques (electric machines), energetics (power transmission and distribution), applied electronics and telecommunication, and computers. No microwave work is done there. The department on computers is particularly active. Their work is divided into 4 groups: hardware, software, automata, and process control. A plaque at the Timis County Museum claims that Timisoara has the distinction of being the first town in Europe with streets illuminated by electric lights, on November 12, 1884.

Cluj with a population of 300,000 is the second largest city (now challenged by Timisoara) in Romania. It has an outstanding botanic garden covering 14 hectares and is also an important medical center. The Polytechnic Institute of Cluj, founded in 1948, has 3 faculties,

in electrical, mechanical, and civil engineering. The Electrical Engineering Faculty has 800 students and is divided into 3 departments: electrotechniques, automation and computers, and electronics. Active work is being conducted on incremental-motion control systems and devices, measurement of nonelectrical quantities, and software system for computer control and optimization.

Jassy, a city of 250,000 in the northeast is only 15 km from the Russian border. Engineering education at Jassy, having its beginning in the early 19th century, is said to have the oldest tradition in Romania. The present "Gh. Asachi" Polytechnic Institute has 6 faculties and an enrollment of 14,000. The Electrical Engineering Faculty has 4 academic departments: electrical measurements and machines, electronics and computers, power utilization and automation, and electro-energetics. The Department of Electronics and Computers has a teaching staff of 18. The areas of specialization are: synthesis of sequential schemes, electronic systems for industrial control, nonlinear circuits, and software design for special problems.

#### GENERAL IMPRESSIONS AND COMMENTS

The purpose of my visit to Poland and Romania was not to seek specific information in my own area of specialization; it was rather to acquire an overview of engineering education in these two countries in general and electronics education in particular. Compared to the US, the engineering curricula in these countries put much more emphasis on the student's ability to design and actually produce some hardware, such as a multipurpose measuring instrument or an automatic control device. Many hours of workshop training are prescribed. This type of education-production integration may be very important in these countries because an engineer is often required to know not only how to design but also how to make a product.

The academic load for the student is heavy, varying from 34 to 38 contact hours a week, exclusive of the workshop activities. The contents and level of the formal courses listed in a 4½-year Polish Mgr. inż. or a 5-year Romanian Ing. degree program are comparable to those for an MSEE degree in the United States. Gymnasium graduates compete for a position at technical universities by taking entrance examination. The examinations are scheduled at the same time, and the admission standards are the same nationwide, hence an aspiring freshman does not have a second chance in the same year. The acceptance ratio is in the neighborhood of 2.5 to 1.

By US standards laboratory and library facilities are poor, especially in Romania. There are few sophisticated instruments, even for research. Set experiments requiring only elementary measuring instruments are found in student laboratories. Lack of adequate financial resources (in particular, foreign exchange) is a serious problem. There



were no minicomputers or time-sharing computer terminals in sight. I was asked to give a lecture and a seminar at the Polytechnic Institute of Bucharest, but no viewgraph or slide projector was to be found, and I was restricted to a small blackboard and chalk with a wet towel as an eraser. Visual aids were available in Poland.

There is no lack of enthusiasm and dedication on the part of the faculty in either country. They realize that they are operating under difficult conditions and that they are behind. They have endured frustrations. Politically and economically both countries belong in the "Eastern Bloc," but the people I talked with, without exception, expressed admiration for the Western system and accomplishments.

Poles and Romanians are frank and generous people. At the universities and academies I was always received cordially and with warmth. I firmly believe that science and technology are independent of national boundaries, races, or political philosophy, and that exchange of ideas and practices will encourage knowledge diffusion and progress. I am glad to have acquired many worthy new acquaintances in Poland and Romania and hope to have made a contribution toward the mutual understanding and friendship among these peoples.



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